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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Application Number: 10/738,403
Filing Date: December 17, 2003
Appellant(s): VAIDYANATHAN, JANAKIRAMAN

John M. Siragusa (Registration No. 46,174)
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 25 April 2008 appealing from the Office

action mailed 4 October 2007.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

US- 4,638,156 A	Horikawa	1-1987
US - 5,144,685 A	Nasar	9-1992
US- 5,821,943 A	Shashua	10-1998

US- 5,995,650 A   Migdal   11-1999

Park et al., "Dual-beam structured-light scanning for 3-D object modeling," 28

May-1 June 2001, IEEE, pages 65-72

Remondino Fabio, "3D Reconstruction of Articulated Objects from Uncalibrated

Images," Jan. 2002, SPIE, Vol. 4661, pages 148-154

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

1.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2.   Claims 1-3, 5, 7-9, and 12-14 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Shashua (5,821,943) in view of Park et al. ("Dual-Beam Structured-

Light Scanning for 3-D Object Modeling").

Regarding claim 1, Shasuha discloses a modeling system for modeling an object

(Fig. 12), comprising: at least one camera (Fig. 12-334, "airborne CCD camera"; col. 13,

line 29); an image grabber that captures a two dimensional (2D) image (Fig. 12-334, "airborne CCD camera … digital images …"; col. 13, lines 29-34) of the object (col. 13, line 31, "terrain"); and at least one image processor (Fig. 12-334, "airborne CCD camera"; col. 13, line 29) that breaks the 2D image into geometric elements (col. 5, lines 57-58, "images can be analyzed on a geometric level") and matches the scanned 3D image with the geometric elements (col. 5, lines 66-67; col. 6, line 1-6, "… the geometrical relations between the corresponding set of 2D points and the set of 3D points from the cloud of points of the 3D world …") to generate the model (col. 5, lines 66-67, "3D world is modeled …"). However, the scanner is not disclosed by Shasuha. Instead of Shasuah, Park teaches a scanner that scans the object to create a three dimensional (3D) image of the object (fig. 3; page 67, section 3.1, "Dual-Beam structured-light scanner to scan the object").

It would have been obvious to one of ordinary skill in the art to apply "a Dual-Beam structured-light scanner to scan the object (fig. 3; page 67, section 3.1) used for 3D object modeling" taught by Park to improve Shashua's invention for the predictable result of enabling 3D object modeling.

Regarding claim 2, Shashua further discloses the 2D image is a 2D gray-tone image (col. 15, lines 55-65, "images can be analyzed on a geometric and photometric level that is the radiometric relation between the scene and the luminosity such, the pixel grey values"); Park further teaches and the 3D image is a 3D stereoscopic image (fig. 3; page 67, section 3.1, "scanning the three dimension of the object using a Dual-Beam structured-light scanner to scan the object").

Regarding claim 3, at least one camera comprises two cameras in a spaced spatial relationship (fig. 12-200 and 210; col. 12, lines 55-65, "3 CCD cameras to yield 3 respective perspectives of the object").

Regarding claim 5, Shashua further discloses further comprising a memory (fig. 11-300; col. 13, lines 9-11) accessible by said at least one processor, wherein the memory (fig. 11-300; col. 13, lines 9-11) stores a geometric element standards library reflecting geometric element characteristics ("The CAD model information generated by CAD S/W (fig. 11-290) from each image triplet is stored in a suitable memory (fig. 11-300; col. 13, lines 9-11)") and wherein said at least one image processor (fig. 11-320, "computational unit") validates the geometric elements by referencing the library (col. 13, lines 17-19, "compares the output unit to a reference CAD model and computes difference").

Regarding claim 7, Parker discloses wherein the scanner is a laser projector that projects a plurality of illuminated stripes on the object (fig. 3; page 67, section 3.1, "Dual-Beam structured-light scanner to scan the object that is an example of a laser projector and generates illuminated stripes.").

Regarding claim 8, Shashua further discloses comprising at least one movable platform supporting at least one of said at least one camera and the object to move said at least one camera and the object relative to each other ("the CCD cameras attached to a robot arm (fig. 11-212) that can move relative to a work piece (col. 12, lines 50-52)").

Regarding claim 9, claim 9 is a method claim corresponding to the claim 1 that is a claim of modeling system for modeling an object. Refer to the explanation of claim 1.

Regarding claim 10, claim 10 is a method claim corresponding to the claim 5 that is a claim of modeling system for modeling an object. Refer to the explanation of claim 5.

Regarding claim 12, claim 12 is a method claim corresponding to the claim 7 that is a claim of modeling system for modeling an object. Refer to the explanation of claim 7.

Regarding claim 13, Park further discloses wherein the projecting step projects the illuminated stripes at a first set of locations, and wherein the scanning step further comprises projecting the plurality of illuminated stripes on the object at a second set of locations different than the first set of locations and capturing at least one image of portions of the object illuminated by the stripes in the second set of locations ("DSLS system that comprises two beam light scanner, left and right. Each of the left and right light scanners generates illuminated stripes, and illuminated stripes generated from the left light scanner do not overlap with illuminated stripes generated from the right scanner (page 67, section 3.1)").

Regarding claim 14, Shashua further discloses wherein the 3D image comprises at least one point cloud, and wherein the matching step comprises:

segmenting said at least one point cloud into a plurality of point cloud segments ("identifying point features in the image that correspond to point features in 3D (col. 5, line 67; col. 6, line 1)"); and matching each of the plurality of point cloud segments with

one of the geometric elements (col. 5, lines 66-67; col. 6, line 1-6, "... the geometrical

relations between the corresponding set of 2D points and the set of 3D points from the

cloud of points of the 3D world ..."); Park further teaches comprising merging the

plurality of point cloud segments to generate the model ("the superposition of cloud of

points detected by the left projector and the right projector (fig. 5)").

3.   Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shashua

(5,821,943) in view of Park et al. ("Dual-Beam Structured-Light Scanning for 3-D Object

Modeling"), and further in view of Nasar et al. (US 5,144,685).

        Regarding claim 4, Shashua and Park disclose and teach all the previous claim

limitations except the detail claim limitations of claim 4. However, Nasar discloses a first

image processor that breaks the 2D image into the geometric elements and a second

image processor that matches the 3D image with the geometric elements ("a first

processor, that is connected to a camera to process the images into an image model

having segmented regions, extracted objects and features, and a third processor that

connected to the first and second processor, that outputs expected site models, to

match expected site models and features from the second processor to extracted

objects and features from first processor (claim 1)").

        It would have been obvious to one of ordinary skill in the art at the time the

invention was made to use Park's method and Nasar's apparatus in Shashua's

apparatus and method for recreating and manipulating a 3D object based on a 2D

projection to provide more feasible method for recognition and verification and to make it able to observe more details of objects as suggested by Nasar (col. 2, lines 13-15).

4.   Claims 6 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shashua (5,821,943) in view of Park et al. ("Dual-Beam Structured-Light Scanning for 3-D Object Modeling"), and further in view of Midgal et al. (US 5,995, 650).

Regarding claim 6, Shashua and Park disclose and teach all the previous claim limitations except the one specified in claim 6. However, Migdal discloses generating a correction matrix ("correction matrix (fig. 3A-225)") reflecting distortion between the 3D image and the geometric elements ("recognizes that distortions in the collected laser beam information can result from problems with the image collector (fig. 1-118)"), wherein said at least one image processor corrects the 3D image based on the correction matrix ("By comparing the reconstructed X, Y, and Z points to the known X, Y, and Z points a specific correction matrix is generated for the image collector (col. 17, lines 67; col. 18, lines 1-13)").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Park's method and Migdal's apparatus in Shashua's apparatus and method for recreating and manipulating a 3D object based on a 2D projection to refine the data for better 3D accuracy as suggested by Migdal (col. 17, lines 65-67).

Regarding claim 11, claim 11 is a method claim corresponding to the claim 6 that is a claim of modeling system for modeling an object. Refer to the explanation of claim 6.

5.   Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shashua (5,821,943) in view of Park et al. ("Dual-Beam Structured-Light Scanning for 3-D Object Modeling"), and further in view of Horikawa et al. (US 4,638,156).

Regarding claim 15, Shashua and Park disclose and teach all the previous claim limitations except the specified ones of claim 15. However, Horikawa discloses controlling a scanning speed based on information from the breaking step ("a light beam scanning apparatus including a control circuit that detects a scan speed of the light beam based on the second signal and adjusts the first signal in response to the detected scan speed to control the scan speed of the light beam such that the detected scan speed substantially coincides with a predetermined speed (abstract)").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Park's method and Horikawa's apparatus in Shashua's apparatus and method for recreating and manipulating a 3D object based on a 2D projection to provide a light beam scanning apparatus requiring minimum manual adjustment in which optimal scanning conditions can be automatically set up and held as suggested by Horikawa (col. 1, lines 63-66).

6.   Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shashua

(5,821,943) in view of Park et al. ("Dual-Beam Structured-Light Scanning for 3-D Object

Modeling"), and further in view of Fabio Remondino ("3-D reconstruction of articulated

objects from uncalibrated images").

        Regarding claim 15, Shashua and Park disclose and teach all the previous claim

limitations except the specified ones of claim 16. However, Remondino teaches the 3D

image comprising at least one point cloud, and wherein the matching step further

comprising at least one of removing outliers and reducing point density in said at least

one point cloud ("automated matching process and a filter to reduce the density of the

point and remove big outliers (page 152, section 3)").

        It would have been obvious to one of ordinary skill in the art at the time the

invention was made to use Park's method and Remondino's method in Shashua's

apparatus and method for recreating and manipulating a 3D object based on a 2D

projection to produce a dense and robust set of corresponding image points, to reduce

the noise in the 3-D data, and to get a more uniform density of the point cloud as

suggested by Remondino (page 152, section 3).

        (10) Response to Argument

        I.   Claims 1 and 9

        1.1   Appellant's argument

        The appellant argues the examiner's combination of Shashua and Park does not

disclose or suggest all the claim features for failing to discloses "breaking the 2D image

into geometric elements and matching the scanned 3D image with the geometric

elements to generate the model" (page 6, lines 1-5), and the rejection of claims 1 and 9 should be withdrawn (page 6, lines 24-25).

2.1   Examiner's argument

Shashua discloses that the 2D images can be analyzed on a geometric level (col. 5, lines 57-58), which means the geometric relation between location of features (points, lines), and the geometrical relations between the corresponding set of 2D points and the set of 3D points is identified (col. 5, lines 66-67; col. 6, line 1-10). The geometric relation between location of features (points, lines) can read on "geometric elements" because any points and lines are the basic elements for a geometric shape of an object; identifying the geometrical relations between the corresponding set of 2D points and the set of 3D points can read on the "matching the 3D image with geometric elements of a 2D image", for the points are features of the image sets. Moreover, because of the points being features of the image sets and geometric elements, identifying point features in the image can be a type of breaking the 2D image into geometric elements. Therefore, the examiner's combination of Park and Shashua is proper for disclosing or suggesting all the claimed features of claims 1 and 9.

1.2   Appellant's argument

The appellant argues that the examiner did not provide any reason as to why anyone would make the combination of Shashua and Park (page 7, lines 5-7) and the combination of Shashua and Park would destroy an intended operation and purpose of Shashua (page 7, lines 8-9).

2.2   Examiner's argument

A.   Even though Both Park and Shashua solve the problem using different

method, it does mean that Park and Shashua is not combinable or teach away from the

combination for both Park and Shashua are related with generating a 3D object or 3D

image based on 2D projection or 2D images. Moreover, the rulings of the Supreme

Court of *KSR v. Teleflex (KSR v. Teleflex*, 550 U.S. ___ support the combination of

Shashua and Park does not destory an intended operation and purpose of the Shashua

without any questions. According to the rulings of the Supreme Court of *KSR v. Teleflex*

(KSR v. Teleflex, 550 U.S. ___ (2007)), the so called teaching, suggesting and

motivation test (TSM) is one of a number of valid rationales that could be used to

determine obviousness, but not the only rationale that may be relied upon to support a

conclusion of obviousness. Shasuha discloses all the claim limitations in claims 1 and 9

except "a scanner that scans ..." and "scanning the object ..." in claims 1 and 9,

respectively. However, Park teaches "a Dual-Beam structured-light scanner to scan the

object (fig. 3; page 67, section 3.1) used for 3D modeling" that reads on the claim

limitations, "a scanner that scans ... " and "scanning the object ...". Thus, it would have

been obvious to one of ordinary skill in the art to apply "a Dual-Beam structured-light

scanner to scan the object (fig. 3; page 67, section 3.1) used for 3D object modeling"

taught by Park to improve Shashua's invention for the predictable result of enabling 3D

object modeling without destroying an intended operation and purpose of Shashua.

B.   The examiner does not find the fact that "more than one camera for

obtaining 2D is not desirable" and "the entire reason for using the scanned light is to

obtain 3D images with only one 3D image" in Park's reference as the applicant argues,

which seems an argument based on the applicant's hindsight rather than the fact or information disclosed by Park. Park is using a light projector(s) and a camera achieves 2D images or projections to generate a 3D object (Figures 1-4; pages 66-67). Sashua utilizes many 2D images to generate a 3D image. So, Both Park and Shashua are related with generating a 3D object or 3D image based on 2D projection or 2D images, and the two references do not teach away from the combination.

    1.3   Appellant's argument

    The appellant argues that the proposed combination will require a change in operation of the Shashua as to destroy its intended operation or inoperable for its intended purpose (page 7, lines 22-23).

    2.3   Examiner's argument

    A.   To combine Park and Shashua, Park's method has to be utilized in Shashua's invention. However, it does not mean the combination will destroy its intended operation or make the combination inoperable for its intended purpose Both Park and Shashua are related with generating a 3D object or 3D image based on 2D projection or 2D images. Moreover, the rulings of the Supreme Court of *KSR v. Teleflex (KSR v. Teleflex*, 550 U.S. ____ support the combination of Shashua and Park does not destory an intended operation and purpose of the Shashua without any questions. According to the rulings of the Supreme Court of *KSR v. Teleflex (KSR v. Teleflex*, 550 U.S. ____ (2007)), the so called teaching, suggesting and motivation test (TSM) is one of a number of valid rationales that could be used to determine obviousness, but not the only rationale that may be relied upon to support a conclusion of obviousness. Shasuha

discloses all the claim limitations in claims 1 and 9 except "a scanner that scans …" and "scanning the object …" in claims 1 and 9, respectively. However, Park teaches "a Dual-Beam structured-light scanner to scan the object (fig. 3; page 67, section 3.1) used for 3D modeling" that reads on the claim limitations, "a scanner that scans … " and "scanning the object …". Thus, it would have been obvious to one of ordinary skill in the art to apply "a Dual-Beam structured-light scanner to scan the object (fig. 3; page 67, section 3.1) used for 3D object modeling" taught by Park to improve Shashua's invention for the predictable result of enabling 3D object modeling without destroying an intended operation and purpose of Shashua.

      B.   Park does disclose methods using one camera, but it is not disclose anywhere that Park's method is trying to eliminate the need for more than one camera and view to reduce accumulation errors and problems with the use of multiple cameras and images, which seems an argument based on the applicant's hindsight rather than the fact or information disclosed by Park. Of course, Park is using only one camera for implementing its method, but there is no information that Park is trying to use only one camera or more than one camera should not be used for the implementation. So, the combination of Shashua and Park is valid without destroying without destroying the primary reference (Shashua)'s intended operation.

      1.4   Appellant's argument

      The appellant argues that Shashua teaches way from the use of a 3D scanned image (page 8, lines 9-10).

      2.4   Examiner's argument

It is not disclosed anywhere that Shashua teaches away the use of a 3D scanned image. Moreover, Shashua and Park are related with generating a 3D object or 3D image based on 2D projection or 2D images, so the two references are combinable as discusses above based on the MPEP ¶2143, which discloses the Supreme Court in KSR International Co. v. Teleflex Inc., 550 U.S. ___, ___, 82 USPQ2d 1385, 1395-97 (2007).

II.   Claim 5.

1.1   Appellant's argument

The appellant argues that geometric standards library reflecting geometric elements characteristics, where image process validates the geometric elements by referencing the library (page 8, lines 18-20).

2.1   Examiner's argument

The examiner argues that Shashua disclose these features. The CAD model information generated by CAD S/W (fig. 11-290) from each image triplet is stored in a suitable memory (fig. 11-300; col. 13, lines 9-11) can read on "the geometric element standards library reflecting geometric element characteristics" and the computational unit (fig. 11-320) comparing the output unit to a reference CAD model and computes difference (col. 13, lines 17-19) can read on the "image process validates the geometric elements by referencing the library."

III.   Claim 4

1.1   Appellant's argument

The processor for matching a 3D image with geometric elements of a 2D image

is not disclosed, and Nasar does not overcome the deficiencies in Shashua and Park

(page 9, lines 4-7).

2.1   Examiner's argument

It has already been discussed above why it is valid to combine Sahshua and

Park for claims 1 and 9. According to the rulings of the Supreme Court of *KSR v.*

Teleflex (KSR v. Teleflex, 550 U.S. ___ (2007)) that teaches that the so called teaching,

suggesting and motivation test (TSM) is one of a number of valid rationales which could

be used to determine obviousness, but not the only rationale that may be relied upon to

support a conclusion of obviousness. Shasuha and Park discloses all the previous claim

limitations of claim 4 except the "first image processor" and "second image processor"

recited in claim 4. However, Nasar discloses a first processor, that is connected to a

camera to process the images into an image model having segmented regions,

extracted objects and features, and a third processor that connected to the first and

second processor, that outputs expected site models, to match expected site models

and features from the second processor to extracted objects and features from first

processor (claim 1). In other words, Naser's disclosure shows that one image processor

is used for breaking the image into geometric elements, and another image processor is

used for matching the geometric elements. It would have been obvious to one of

ordinary skill in the art to use the methods of Sahshua and Park to use one image

processor for breaking the image into geometric elements and another image processor

for matching the geometric elements taught by Naser. Therefore, the examiner's

proposed combination of Shashua, Park, and Naser is proper, and the rejection will not be withdrawn.

    IV.   Claims 6 and 11

    1.1   Appellant's argument

    The appellant argues that Migdal dose not disclose the correction matrix reflecting distortion to correct a 3D image in view of geometric elements (page 9, lines 16-18).

    2.1   Examiner's argument.

    The examiner argues that Migdal does disclose the correction matrix of claim 6. Migdal discloses correction matrix (fig. 3A-225), which recognizes the distortions in the collected laser beam information can result from problems with the image collector (fig. 1-118) by comparing the reconstructed x, y, and z points to the known X, Y, and Z points a specific correction matrix is generated for the image collector (col. 17, lines 67; col. 18, lines 1-13), that is not an image collection calibration device, but a 3D image correction method because of using the geometric elements of 3D image – x, y and z points.

    V.   Claims 15

    1.1   Appellant's argument

    The appellant argues the speed being adjusted based on the information for the breaking step is not disclosed by the proposed combination (page 10, lines 4-5).

    2.1   Examiner's argument

The examiner argues that Horikawa discloses a light beam scanning apparatus including a control circuit that detects a scan speed of the light beam based on the second signal and adjusts the first signal in response to the detected scan speed to control the scan speed of the light beam such that the detected scan speed substantially coincides with a predetermined speed (abstract), which is the step of adjusting the speed based on the information.

VI.   Claim 16

1.1   Appellant's argument

The appellant argues that Remondino does not overcome the deficiencies in Shashua and Park (page 10, lines 10-11).

2.1   Examiner's argument

The examiner argues that Shashua and Park disclose all the claim limitations of claim 9 and Remondino discloses the specified claim limitation of claim 16.

VII.   Conclusion

1.1   Appellant's argument

The appellant argues that the rejection of claims 1-16 is improper and should be reversed (page 10, lines 15-16).

2.1   Examiner's argument

The examiner argues that the rejection to claims 1-16 is valid and will not withdraw.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the

Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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